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ENSEMBLE CLASSIFICATION OF INDIVIDUAL TREE SPECIES FROM MULTISPECTRAL SATELLITE IMAGERY AND AIRBORNE LIDAR DATA

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ABSTRACT:

Accurate tree species information within forests is critical for forest activities and environmental modelling at the local and regional scales. This study evaluated the performance of applying ensemble techniques to automatically distinguish two conifer species (*Pinus sylvestris* L. and *Pinus uncinata* Mill. Ex Mirb) within a one square kilometer forested area located in Barcelonnette in the southern French Alps. Three classification schemes were examined: based on (1) high-density LiDAR data (160 p/m^2) derivatives, (2) spectral image layers derived from multispectral imagery (Worldview-2), and (3) both the spectral and LiDAR derived layers. Crown segmentation was done as a pre-processing step for estimation of crown variables. Physical independent variables for instance, the height metrics, return intensity distributions and crown parameters (e.g., crown diameter, crown width-length ratio, crown perimeter length and canopy closure) were extracted from the height-normalized LiDAR data for each delineated crown. Vegetation indices (e.g. NDVI and MNDVI) and the canopy surface albedo were derived from the optical image as the spectral independent variables. Selection of the best predictor subset was based on AUC Random Forests with cross validation. To classify the species, ensemble models consisting of 9 regression techniques were used i.e. Classification and Regression Trees, Generalized Linear Models, Generalized Boosting Models, Generalized Additive Models, Artificial Neural Networks, Flexible Discriminant Analysis, Multiple Adaptive Regression Splines, Random Forests and Maxent. Predictions were evaluated using cross validation and an independent dataset. Integration of datasets improved species classification (TSS = 0.66) and ensemble models had higher predictive power (up to AUC = 0.91) compared to either datasets or models used in isolation. Assemblage of regression models and integration of the datasets provided increased predictive capabilities and more reliable species distribution maps at individual tree resolution.